AMENDMENTS TO THE SPECIFICATION:

Please amend the paragraph beginning on line 2 of page 8 as follows:

B1

Figure 12 shows scatter diagrams of the output of an differential de-mapper of [[a]] an MCM receiver for illustrating the effect of an echo phase offset correction;

Please amend the paragraph beginning on line 4 of page 12 as follows:

B2

A second method of differential mapping is shown in Figure 2B. The present invention is adapted for MCM transmission system using the mapping scheme shown in Figure 2B. This mapping scheme is based on a differential mapping inside one MCM symbol along the frequency axis. A number of MCM symbols 200 [[is]] are shown in Figure 2B. Each MCM symbol 200 comprises a number of sub-carrier symbols 202. The arrows 204 in Figure 2B illustrate information encoded between two sub-carrier symbols 202. As can be seen from the arrows 204, this mapping scheme is based on a differential mapping within one MCM symbol along the frequency axis direction.

Please amend the paragraph beginning on line 9 of page 18 as follows:

B3

The output of the MCM demodulator 314 is also applied to fine frequency error detector 320. The fine frequency error detector 320 produces [[an]] a frequency error signal from the output of the MCM demodulator. In the depicted embodiment, the output of the fine frequency error detector 320 is applied to a numerical controlled oscillator 322 via a loop filter 324. The loop filter 324

Cont B3

is a low pass filter for filtering superimposed interference portions of a higher frequency from the slowly varying error signal. The numerical controlled oscillator 322 produces a carrier signal on the basis of the filtered error signal. The carrier signal produced by the numerical controlled oscillator 322 is used for a frequency correction which is performed by making use of a complex multiplier 326. The inputs to the complex multiplier 326 are the output of the low pass filter and decimator unit 312 and the output of the numerical controlled oscillator 322.

Please amend the paragraph beginning on line 31 of page 18 as follows:

B4

The fine frequency error detector 320 comprises a differential detector in the time axis 330. The output of the MCM demodulator 314, i.e. the FFT output (FFT = Fast Fourier Transform) is applied to the input of the differential detector 330 which performs a differential detection in the time axis in order to derive information on a frequency offset from the same sub-carrier of two subsequently arriving MCM symbols. In the embodiment shown in Figure 7, the number of active sub-carriers is 432. Thus, the differential detector 330 performs a correlation between the first and the 433rd sample. The first sample is associated with MCM-symbol-1 (Figure 5), whereas the 433rd sample is associated with MCM-symbol-2 (Figure 5). However, both <u>of</u> these samples are associated with the same sub-carrier.

Please amend the paragraph beginning on line 28 of page 19 as follows:

B5

The output Z_k of the differential detector 330 contains [[a]] an M-fold uncertainty corresponding to codeable phase shifts. In case of the QPSK mapping, this M-fold uncertainty is a 4-fold uncertainty, i.e., in the 0°, 90°, 180° and 270°phase shifts. This phase shift uncertainty is eliminated from the output Z_k [making use of a] by using an M-PSK decision device 340. Such decision devices are known in the art and, therefore, [[have]] are not [[to be]] described here in detail. The output of the decision device 340 $(\hat{a}_k)^*$ represents the complex conjugate of the codeable phase shift decided by the decision device 340. This output of the decision device 340 is correlated with the output of the differential detector 330 by performing a complex multiplication using a multiplier 342.

Please amend the paragraph beginning on line 5 of page 20 as follows:

B6

The output the multiplier 342 represents the phase offset for the respective sub-carriers. [[This]] The phase offsets for the respective sub-carriers are averaged over one MCM symbol in an averaging unit 344 in accordance with a preferred embodiment of the present invention. The output of the averaging units 344 represent the output of the fine frequency error detector 320.

Please amend the paragraph beginning on line 24 of page 21 as follows:

B7

As described above, the frame/timing synchronization unit uses the amplitude-modulated sequence in the received signal in order to extract the framing information from the MCM signal and further to remove the guard intervals

Cont B7

therefrom. After the frame/timing synchronization unit 360 it follows a coarse frequency synchronization unit 362 which estimates a coarse frequency offset based on the amplitude-modulated sequence of the reference symbol of the MCM signal. In the coarse frequency synchronization unit 362, a frequency offset of the carrier frequency with respect to the oscillator frequency in the MCM receiver is determined in [[oder]] order to perform a frequency offset correction in a block 364. This frequency offset correction in block 364 is performed by a complex multiplication.

Please amend the paragraph beginning on line 9 of page 26 as follows:

B8

In case of a channel with strong reflections, for example due to a high building density, the correlations described above might be insufficient for obtaining a suitable coarse frequency synchronization. Therefore, in accordance with a third embodiment of the present invention, corresponding values of the two portions (i.e., which are correlated in accordance with a second embodiment) [, can be weighting] can be weighted with corresponding values of stored predetermined reference patterns corresponding to said two identical sequences of the reference symbol. This weighting can maximize the probability of correctly determining the frequency offset. The mathematical description of this weighting is as follows:

Please amend the paragraph beginning on line 13 of page 27 as follows:

B9

Systematic phase shifts stemming from echoes in multipath environments may occur between subcarriers in the same MCM symbol. [[This]] These phase offsets can cause bit

Cont B9

errors when demodulating the MCM symbol at the receiver. Thus, it is preferred to make use of an algorithm to correct the systematic phase shifts stemming from echoes in multipath environments.

Please amend the paragraph beginning on line 20 of page 27 as follows:

B10

In Figure 12, scatter diagrams at the output of a differential demapper of [[a]] <u>an</u> MCM receiver are shown. As can be seen from the left part of Figure 12, systematic phase shifts between subcarriers in the same MCM symbol cause a rotation of the demodulated phase shifts with respect to the axis of the complex coordinate system. In the right part of Figure 12, the demodulated phase shifts after having performed an echo phase offset correction are depicted. Now, the positions of the signal points are substantially on the axis of the complex coordinate system. These positions correspond to the modulated phase shifts of 0°, 90°, 180° and 270°, respectively.

Please amend the paragraph beginning on line 38 of page 27 as follows:

B11

For illustration purposes, one may think of the simplest algorithm possible which eliminates the symbol phase before computing the mean of all phases of the subcarriers. To illustrate the effect of such an EPOC algorithm, reference is made to the two scatter diagrams of [[subcarriers]] <u>subcarrier</u> symbols contained in one MCM symbol in Figure 12. [[This]] <u>These</u> scatter diagrams have been obtained as result of an MCM simulation. For the simulation<u>,</u> a channel has been used which might typically show up in single frequency networks. The echoes of this channel stretched to the limits of the MCM

Cont B11

guard interval. The guard interval was chosen to be 25% of the MCM symbol duration in this case.

Please amend the paragraph beginning on line 13 of page 28 as follows:

B12

Figure 13 represents a block diagram for illustrating the position and the functionality of an echo phase offset correction device in [[a]] an MCM receiver. The signal of a MCM transmitter is transmitted through the channel 122 (Figures 1 and 13) and received at the receiver frontend 132 of the MCM receiver. The signal processing between the receiver frontend and the fast Fourier transformator 140 has been omitted in Figure 13. The output of the fast Fourier transformator is applied to the de-mapper, which performs a differential de-mapping along the frequency axis. The output of the de-mapper are the respective phase shifts for the subcarriers. The phase offsets of [[this]] these phase shifts, which are caused by echoes in multipath environments, are [[visualized]] illustrated by [[a]] block 400 in Figure 13, which shows an example of a scatter diagram of the subcarrier symbols without an echo phase offset correction.

Please amend the paragraph beginning on line 2 of page 29 as follows:

B13

A first embodiment of an EPOC algorithm and a device for performing the same is now described referring to Figure 14.

Please amend the paragraph beginning on line 19 of page 36 as follows:

B14

The two plots in Figure 15 show the projection of the EPOC algorithm of the second embodiment for one quadrant

of the complex plane. Depicted here is the quadratic grid in the sector $|\arg(z)| \leq \pi / 4$ and the straight line $y = f(x) = a + b \cdot x$ with a = -1.0 and b = 0.5 (dotted line). In case of a noise-free channel, all received symbols will lie on this straight line if 1+j0 was [[send]] sent. The circle shown in the plots determines the boarder line for the two cases of Equation 40. In the left part, Figure 15 shows the situation before the projection, in the right part, Figure 15 shows the situation after applying the projection algorithm. By looking on the left part, one can see, that the straight line now lies on the real axis with 2+j0 being the fix point of the projection. Therefore, it can be concluded that the echo phase offset correction algorithm according to the second embodiment fulfills the design goal.

B14

Please amend the paragraph beginning on line 16 of page 38 as follows:

Besides the two EPOC algorithms explained in the above section, different algorithms can be designed that will, however, most likely exhibit a higher degree of computational complexity.

B15

Please amend the "Abstract of the Disclosure" section of the specification following the claims as follows:

A method and an apparatus [relate] relating to a fine frequency synchronization compensating for a carrier frequency deviation from an oscillator frequency in a multi-carrier demodulation system of the type capable of carrying out a differential phase decoding of multi-carrier modulated signals, the signals comprising a plurality of symbols, each symbol being defined by phase

B16

differences between simultaneous carriers having different frequencies. A phase difference between phases of the same carrier in different symbols is determined. Thereafter, a frequency offset is determined by eliminating phase shift uncertainties related to the transmitted information from the phase difference making use of a M-PSK decision device. Finally, a feedback correction of the carrier frequency deviation is performed based on the determined frequency offset. Alternatively, an averaged frequency offset can be determined by averaging determined frequency offsets of a plurality of carriers. Then, the feedback correction of the frequency deviation is performed based on the averaged frequency offset.

B16